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APPARATUS AND METHOD FOR MERGING ITEMS TO BE SORTED

This invention relates to an improved apparatus and method for merging a series of items, such as items of mail, into a sorted sequence of similar items. In particular, the invention has application in a system for inserting at the correct location items of mail that have been initially rejected in a first sort into the sorted sequence of mail.

Machines for sorting items into a predetermined order are known. The mail industry widely use such machines at delivery stations in order to sort items of mail or 'mail-pieces' into a suitable order for delivery by a postal worker. The order typically corresponds to the order in which the postal worker visits the addresses on his route in order to deliver the mail. An improved sorting machine is disclosed in the applicant's UK patent application no. 0100503.3.

US patent 3674143 discloses a transport and sorting mechanism for mail-pieces and the like. The mechanism directs articles to be sorted to two series of receptacles in parallel. The bottom of the floor of a receptacle is formed of two slanting or inclined support members. When it is desired to empty the receptacles, an eject arm is activated to move in a direction along the inclined support members to push the mail-pieces resting on the support members onto a sweeping conveyor.

Such sorting machines are required to process quickly and reliably a large number of items of mail, and direct them precisely to a predetermined sorting bin. Current numbers for the amount of mail processed by sorting machines in one hour are of the order of 30,000 items.

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Invariably, during the sorting process some items of mail cannot be transported correctly to the predetermined sorting bin. Reasons for a mail piece failing to reach the sorting bin are varied, and include mechanical failure of the guide means directing the mail item, inability to distinguish the address or the address code on the exterior of the mail item, and irregularities in the size and or shape of the mail item preventing it from passing through the guide means smoothly. Items of mail which are not successfully transported to their designated sorting bin will be referred to as "rejected items" in this application, and typically comprise up to 30% of the total number of mail-pieces sorted by the sorting machine. Rejected items also includes items which cannot be included in the sort, because they are over-sized or are fragile for example, as well as any other items that are to be added to the sorted items after the sort has taken place.

In known systems, the rejected items are output from a sorting machine or sequencing apparatus, collected by a postal worker and sorted manually into the sort order employed by the sorting machine. Once the sorting machine has finished its sort, an operator inserts the rejected items into the respective appropriate sorting bins of the sorting machine according to their address. Typically, each of the sorting bins has an indicator, such as a light or flag, and the operator can enter the address of a rejected item of mail at a user input station, to cause the indicator light or flag of the appropriate sorting bin to be activated, indicating the sorting bin into which the rejected item is to be inserted.

Despite the use of such indicators, the process of inserting rejected items of mail is still very time consuming. Sorting machines used in the postal industry

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have a large number of sorting bins, and not only is difficult for a postal worker to quickly spot the indicator for the appropriate sorting bin from all the other sorting bins in the sorting machine, but often
5 because of the size of the array of sorting bins, the postal worker will often have to move backwards and forwards along the array of bins in order to insert the rejected mail. We have appreciated therefore that the present system of inserting rejected items of mail into
10 the sequence of sorted mail is time consuming for postal workers. As a result, less mail can be sorted by the sorting machine per hour because time is wasted following a sort reinserting rejected items of mail back into the sorted items of mail.

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Summary of the Invention

The invention is defined in the independent claims to which reference should now be made. Advantageous features are set forth in the dependant claims.

20 An improved apparatus and method for merging items into a pre-sorted sequence of items are provided. The apparatus has a series of linked movable receptacles or bins which correspond to the sorting bins of a sorting machine with which the apparatus can be used. Each sorting
25 bin and each corresponding movable bin are allocated a location in a sort sequence. Operating the sorting machine results in the sort items being deposited in the sorting bins and thereby sorted according to the sort sequence. Following sorting, the items are output into the moveable
30 bins. Items that cannot be stored in this way are collected together as rejected items.

A user of the preferred apparatus can enter the address data of a rejected item into an input device

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connected to apparatus control means. The control means causes the linked movable bins to move such that the merging bin allocated the position in the sort sequence given by the address data entered by the user is brought
5 to a position in which the user can insert the rejected item.

This allows the process of returning rejected items into the sort at their respective positions to be faster than if the user of the sorting machine has to identify
10 for themselves the location at which the rejected item should be inserted. In the postal industry, this allows more letters to be properly sorted in a shorter time, leading to shorter delivery times, and increased efficiency.

15 Preferably, the linked moveable merging bins are mounted on a conveyor system and are comprised of a number of slats. When the address data of a rejected item is entered the conveyor is moved so that the slats defining the merging bin into which the rejected item is to be
20 inserted are positioned at the curving end of the conveyor where they fan out and make insertion of the rejected item easier.

Preferably, the linked moveable merging bins are positioned adjacent to the sorting bins of the sorting
25 machine and are aligned with the sorting bins such that a push-plate disposed between the sorting bins can transfer mail from the sorting bins to the merging bins by pushing it across from the sorting bin into the merging bin.

30 Preferably, an encapsulating machine is also provided to individually wrap into a single bundle of mail items destined for the same location in the sort sequence.

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Brief Description of the Drawings

The invention will now be described in more detail, by way of example, with reference to the accompanying drawings in which:

5 Fig. 1 is a perspective view showing the improved merging apparatus in a first embodiment;

 Fig. 2 is a flow diagram illustrating the steps performed by a user and performed by the control means of the preferred improved apparatus shown in Figure 1, in a
10 first and second embodiment;

 Fig. 3 is a simplified perspective view showing the improved merging apparatus in a third embodiment; and

 Fig. 4 is a flow chart showing the steps performed by a user and by the control means of the improved merging
15 machine in a third embodiment.

Description of the preferred Embodiment

The invention in a first preferred embodiment is illustrated in Figure 1 to which reference should now be
20 made. Figure 1 shows an improved apparatus 1 comprising an improved merging apparatus 2 and encapsulating apparatus 4 connected to each other by means of an output conveyor 6. The improved apparatus is particularly suited for handling mail items, but is not limited to such items. In the case
25 of a merging apparatus used for purposes other than for merging mail items, any references to the address of a rejected item, may be understood as references to a location in a sort sequence, such as a name or a code.

 The merging apparatus 2 comprises a housing 10 on
30 which a conveyor 12 is mounted. The surface of the conveyor is provided with links or attachment points for mounting a number of rows of slats or plates 14 in regular spaced alignment across the length of the conveyor. Each

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row is comprised of three slats, 14a, 14b and 14c, disposed across the width of the conveyor and angled with respect to the vertical to provide a flat surface against which a mail piece can rest. The three slats are spaced
5 apart from one another across the width of the conveyor to leave gaps which correspond to the positions of three conveyors of output conveyor 6. The space between adjacent rows of the slats define individual merging bins or receptacles 16 in which mail-pieces can be received. Thus,
10 the slats 14 and the spaces between them define a series of linked moveable merging bins.

Conveyor 12 has an output end 36 where it meets the input end of conveyor 6. Output end 36 of conveyor 12 curves to allow the conveyor 12 to pass back underneath
15 housing 10.

Shown adjacent to the slats 14 of conveyor 12 in Figure 1, is an array of sorting bin divider plates 20 disposed to receive sorted mail from a sequencing or sorting apparatus (not shown). The sorting bin divider
20 plates 20 are angled away from the vertical towards the direction of mail-pieces approaching from the sequencing apparatus in order to provide a sloped surface against which mail-pieces rest when they come to a stop. The sorting bin divider plates 20 are mounted on a second
25 housing section 22; the second housing is linked to the housing 10. The space between the respective sorting bin divider plates 20 defines sorting bins of the sequencing apparatus in which sorted items of mail may be received.

The slats 14 defining the merging bins 16 are angled
30 away from the normal to the conveyor, such that when the slats 14 are positioned on the flat top surface of the conveyor, they are angled by the same amount from the vertical as the sorting bins. The spacing between the rows of slats 14 is identical to the spacing between the
35 sorting bin divider plates 20 so that the slats 14 and the

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sorting bin divider plates 20 can be brought into close horizontal alignment with each other.

Each of the sorting bin divider plates 20 is provided with a push-plate 24 mounted on guide tracks 26. The push-plate 24 is controlled by control means (not shown) and is for pushing items of mail 28 which have come to rest against the sorting bin divider plate 20 across the plate and on to the slats 14 of a merging receptacle 16.

Output conveyor 6 comprises three conveyors 30, 32, 34. Conveyors 30 and 32 are each aligned with a respective gap between the two slats 14a and 14b, and the two slats 14b and 14c on conveyor 12. Conveyor 34 on the other hand is aligned to be adjacent with the end of the rows of slats, between the sorting bin divider plates 20 and the conveyor 12. The output conveyor 6 extends from the output end 36 of conveyor 12 to the encapsulating machine 4.

The slats 14 are brought towards the output conveyor 6 by the movement of conveyor 12. As they reach the output end 36 of conveyor 12, slats 14b and 14c pass between conveyor 30 and 32, and 32 and 40 respectively, while slat 14a passes along the outside edge of conveyor 30. The curvature of conveyor 12 causes the slats to angle downwards, passing through the conveyor 30, 32 and 34, before passing back along the underside of housing 10. In Figure 1, the rows of slats are shown as ending at the point on the conveyor just beyond its output end. However, this is only for the sake of clarity and it will be appreciated that the entire surface of conveyor 12 may be provided with rows of slats defining receptacles 16. The number of rows of merging bins and the length of conveyor 12 depends on the number of sorting bins of the sequencing apparatus which are to be matched.

The preferred apparatus also comprises an operator station though this is not shown in Figure 1. The operator station comprises a work station having at least an input

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device for inputting the address information of rejected items. The operator workstation is situated close to the conveyor 12, such that an operator of the merging apparatus can insert rejected items of mail into a merging
5 bins without moving away from the operator station. The preferred input position or merging position for a merging bin is reached when the slats 14 of the receptacle are positioned on the curving end of the conveyor 12. In this position, they are fanned out or spread slightly by the
10 curvature of the conveyor, making it easier for the operator to insert a rejected item. It is therefore preferred if the operator station is situated close to the output end 36 of the conveyor.

A similar spreading or fanning effect could also be
15 achieved in alternative embodiments by having a conveyor 12 that is curved on its top surface, or that has at least a curving portion on its top surface (as well as at its ends), rather than being substantially flat. This would allow the input position and the operator station to be
20 positioned elsewhere than at the output end of the conveyor 12.

Conveyors 30, 32 and 34 are supported in position between the slats and abutting the output end of conveyor 12 by supports. These are also omitted for the sake of
25 clarity in Figure 1.

The end of output conveyor 6 distant from that abutting conveyor 12 is supported against the input end of encapsulating apparatus 4. The encapsulating apparatus 4 comprises means for wrapping mail-pieces with a covering
30 such as paper, polyurethane or foil for example. Once wrapped the mail-pieces are output onto output conveyor 40, and are ready for collection by a postal worker for delivery.

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The operation of the improved merging apparatus will next be described with particular reference to Figures 2 and 3.

Figure 2 is a flow chart which shows schematically the steps taken by both an operator of the improved merging apparatus and those taken by the control means controlling the improved merging apparatus. The operator or user steps are shown on the left hand side of Figure 2 and are labelled U10 to U60. The control means steps are shown on the right hand side of the diagram and are labelled C10 to C100. It will be appreciated that the steps implemented by the control means may be provided as either software or hardware.

The improved merging apparatus is intended to be used together with a sequencing or sorting apparatus. The steps shown in figure 2 therefore suppose that items of mail have first been input into a sorting apparatus and that the sorting apparatus has been provided with a sort sequence into which the items of mail are to be sorted.

The operation of the control means therefore begins in step C10 in which the control means of the merging apparatus is provided with the same sort sequence supplied to the sorting machine. The sort sequence information will comprise an ordered list of addresses corresponding to the addresses on the mail delivery worker's delivery route, as well as information defining a sorting bin in the sorting apparatus which is to receive mail intended for that address. In preferred sorting systems, such as that disclosed in the applicant's own UK patent application number 0100503.3, addresses for which no mail is to be delivered are omitted from the ordered list and accordingly have no sorting bin allocated to them. Furthermore, depending upon the amount of mail intended for a particular address, more than one sorting bin may be

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allocated to an individual address in order to accommodate all of the mail that is to be delivered.

The control means uses the sort sequence information to allocate the receptacles or merging bins defined by slats 14 on conveyor 12 with addresses such that they are in one-to-one correspondence with the sorting bins of the sorting machine. That is to say the merging bins are mapped to the same addresses and in the same order as the sorting bins of the sorting machine; the addresses and the order being defined by the sort sequence.

In the preferred embodiment of the improved merging apparatus, the control means keeps track of the position of a particular sorting bin, and the address assigned to a particular sorting bin by measuring the length of the conveyor 12 from a particular reference point provided on its surface. A series of sensors is provided in the housing 10 to cooperate with conveyor 12 in order to detect its position. A reference point may then be marked on the surface of conveyor 12 using any suitable means for engaging with the series of sensors, such as a magnet or an arm extending from the conveyor. Defining the location of a receptacle and referencing a particular receptacle can then be achieved by giving a distance in a particular direction from the reference point on the conveyor surface. A simple look-up table can then be used, listing the distance to a receptacle and the allocated address for that receptacle.

Having mapped the merging receptacles 16 to the sorting bins of the sequencing apparatus, the control means waits at step C30 to receive an indication that the sequencing apparatus has finished its sort of the mail items. Whether an end of sort indication has been received already by the time the control means passes control to step C30, will depend upon the time at which the sort information was first received in step C10. Preferably,

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the sort information is transmitted to the control means as early as possible, so that the merging apparatus can be in a ready state by the time the sequencing apparatus has finished its sort. This will save time compared to the
5 situation where the sort is completed before the sort sequence information is transmitted to the merging apparatus.

Once an end of sort indication has been received in step C30, control passes to step C40 where the control
10 means ensures that the slats 14 disposed on the conveyor and defining the receptacles are correctly aligned with the sorting bin divider plates 20. This may be achieved by ensuring that the reference point on the conveyor 12 is aligned with a particular reference position on the
15 housing 10.

In alternative embodiments, reference means may also be provided at each row of slats on the conveyor 12 so that the exact position of each row may be determined directly from the reference means and the series of
20 sensors without having to calculate the length from a single point on the surface.

Once the slats 14 of the receptacles are correctly aligned with the sorting bin divider plates, the control means activate the push-plates 24 situated between each of
25 the respective divider plates 20 in the sorting bins. Mail-pieces 28 in respective sorting bins are pushed horizontally from the sorting bin into the receptacle 16 defined by the slats 14. The push-plates 24 are then returned by the control means to their resting position in
30 between the sorting bins. The control means issues an indication in step C60 that the sort bins are empty. On receipt of the sort bin empty indication, the sequencing apparatus is then ready to perform another sort of mail items.

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Control then flows to step C70 in which the control means awaits input from a user or operator of the improved merging apparatus.

5 The steps that the operator or user performs in conjunction with those of the control means of the improved merging apparatus will now be described up to the point at which the control means awaits user input in step C70.

10 An operator of the improved apparatus or a postal worker first receives in step U10 rejected items of mail from the sort of the sequencing apparatus.

15 Next, in step U20, the operator or postal worker manually sorts the rejected items into an order corresponding to the sort order employed by the sorting apparatus. The manually sorted items are then brought to the operator station of the improved sorting machine. At the operator station is an input device, such as a keyboard or scanner for example, for entering the address data of the rejected items of mail.

20 In step U30, the user of the improved merging apparatus takes the first rejected item from his pile of rejected items and inputs its address into the input device. The data input by the user is communicated to the control means at step C70. In response the control means
25 determine the receptacle to which that address has been allocated, with reference to the sort sequence information and the look-up table referencing the receptacle. Control then passes to step C70 in which the control means operates the conveyor 12 such that the receptacle 16
30 corresponding to the address entered by the user is brought forward to the output end of the conveyor 12 and within a comfortable reaching distance of the operator's work station. Preferably, the conveyor 12 is advanced forward such that the slats 14 of the receptacle 16 into
35 which the rejected item is to be inserted are brought into

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the input or merging position where they are caused to fan out as they pass partially over the curved end of the conveyor 12.

5 In step U40, the operator of the merging apparatus inserts the rejected item of mail into the appropriate receptacle and returns the rejected item of mail to the correct position in the sorted sequence of mail.

10 As the conveyor 12 is being moved forward to bring the appropriate receptacle 16 into the position for the user to insert the rejected item, the contents of the receptacles in advance of that receptacle are brought towards the output end 36 of the conveyor 12. As the slats 14 defining one side of a receptacle 16 are brought towards the output end of the conveyor 12 they pass
15 between and through the conveyor of output conveyor 6. In doing so, the items of mail contained in the receptacle are brought into contact with the surface of output conveyor 6 and are carried away to encapsulating machine 4. The encapsulating machine wraps the mail items
20 contained in each receptacle into a single bundle, making them easier to deliver and provides protection against any adverse weather conditions encountered during delivery.

Having inserted the item into the appropriate receptacle, the user gives an indication in step U50 by
25 activating a button on the workstation or input device for example, as to whether there are any more rejected items to be inserted. The control means monitors this indication in step C90, and if there are further items, returns to step C70 to await user input, wherein the user can then
30 enter successive address data of the rejected items.

The control means successively moves the receptacles into which rejected items are to be inserted forward to the input or merging position. In doing so, the control means remembers the distance the conveyor has been moved

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to the last receptacle, and subtracts this from the distance given in the look-up-table.

If there are no further items to be inserted into the receptacles, then control flows from step C90 to end step
5 C100 in which the control means activates conveyor 12 such that all of the mail in the receptacles is brought to the output end of the conveyor 12 for output and wrapping by encapsulation machine 4.

In the example operation of the merging apparatus
10 described above, it has been assumed that each address in the sort sequence is allocated to a single receptacle 16 on the conveyor 12. However, as indicated earlier, where a large amount of mail is to be delivered to a particular address, the control means of the sequencing apparatus
15 will allocate more than one sorting bin to that address in the sort sequence. Accordingly, more than one merging bin or receptacle will also be allocated a single address. If the user in step U30 inputs such an address, then the control means will advance the conveyor 12 such that the
20 receptacle corresponding to the sort bin into which the last of the mail for that address arrived is positioned at the output end of the conveyor 36. It will be appreciated that this sort bin, and the corresponding receptacle, are less likely to be full with mail items than the sorting
25 bins into which mail for that address arrived first. The appropriate receptacle may be the receptacle 16 closest to the output end 36 of the conveyor or it may be the receptacle furthest away from the output end of the conveyor. Whether it is the closest or the furthest
30 receptacle, will of course depend on the order in which the sorting bins are filled in the sequencing apparatus. This can be determined from the sort sequence information.

In cases where more than one receptacle is allocated to a single address in the sorting sequence, the control
35 means issues a wait command to the encapsulating apparatus

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4 to prevent it from bundling the mail together until the contents of all of the receptacles for that address have been received. This prevents mail intended for a single address being bound up into several bundles.

5 If preferred, however, this feature may be overridden such that the contents of each receptacle are bound as a single bundle. This might be beneficial for example if it is desired to limit the size of the outgoing bundles of mail to a particular size.

10 The example operation of the improved merging apparatus described above, relies on the user manually sorting the rejected items of mail into the sort sequence before operating the improved merging apparatus. Manual sorting is necessary because the contents of the
15 receptacles in advance of the receptacle whose address is input for merging are automatically output by means of output conveyor 6 as the conveyor moves forward. It is not possible once the contents of a receptacle 16 have been output onto output conveyor 6 and have been wrapped to add
20 a rejected item to them. As a result of this the rejected items must be input into the merging apparatus in an order corresponding to the sort sequence. Doing so however, allows the merging apparatus to be relatively compact such that it does not take up too much space on the floor of
25 the delivery office.

 However, in certain search systems, it may be preferable to provide the facility to input rejected items into the improved merging apparatus without any prior manual sorting. Such systems, may take up more space in
30 the delivery office, but provide the advantage of shortening the operation time.

 A second embodiment of the invention provides a simple way of doing this using the apparatus shown in figure 1. In this embodiment, the user in step U30 of
35 Figure 2, inputs the address data for all of the rejected

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items together at the same time. The control means logs the receptacles 16 which are to have rejected items inserted into them, and in control step C80, moves the first receptacle 16 which is to receive a rejected item is
5 and which is closest to the output end of the conveyor 12 to the output end 36 of the conveyor. The control means then displays the address corresponding to that receptacle to the user at the user workstation. The user then selects the indicated appropriate rejected item from his pile of
10 rejected items and inserts it into the already positioned receptacle, indicating that he has done so by pressing a button for example at his workstation.

The control means then moves the next closest receptacle to which a rejected item is to be inserted into
15 position at the output end of the conveyor. This process is repeated until the user has input all of the rejected items into the appropriate receptacles of the conveyor 12. As a result, the manual sorting is performed at the same time as the rejected items of mail are inserted into the
20 receptacles with the assistance of the control means.

A third embodiment of the improved merging apparatus, provides further means for inserting the rejected items into the merging bins without the requirement for them to be pre-sorted into the correct order. To do this, it is
25 necessary to be able to retain the contents of the receptacles 16 within the receptacles until all of the rejected items have been inserted, and the receptacles can be moved to an output position. This will now be described with reference to Figures 3 and 4.

30 In the third embodiment of the improved merging apparatus, shown in Figure 3, the conveyor 12 is of such a length as to accommodate receptacles corresponding to all of the sort bins on its upper surface as well as additional space 40 such that each receptacle can be
35 brought to the input or merging position without meeting

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the output conveyor 6 (not shown). This is achieved by arranging the conveyor so that the additional space on its surface extends out to either side of the row of sorting bins. The output conveyor and the encapsulating machine
5 are not shown in Figure 3.

It will be appreciated that in order to accommodate sufficient space the total length of the conveyor will need to be approximately three times the length required for the receptacles 16. The apparatus shown in Figure 3
10 comprises a straight conveyor which is preferred for purposes of illustration. In practice however, a single straight conveyor 12, is likely to be difficult to implement for anything but a relatively small number of receptacles. A curved conveyor for example may be
15 preferable or a conveyor that follows an S shape in order to better utilise space. The receptacles 16 may then be brought into alignment with the sorting bins of the sequencing apparatus to receive the output sorted mail, but then, as the conveyor is moved backwards and forwards
20 to position an appropriate receptacle at an insertion point, may be moved away from the sorting bins along the arms of the S shape for example. The output conveyor 6 is then positioned so that it abuts one end of the S shape or curve so that mail can be output easily from the conveyor
25 in the same way as before.

In this embodiment, an alternative facility for inserting rejected items of mail is provided in the form of a guide or feeder tray 42 positioned above the insertion point. As the address of a rejected item of mail
30 is entered by a user, the control system moves the merging bins such that the merging bin corresponding to the address of the rejected item of mail is underneath the feeder tray. The feeder tray has a wide mouth for inserting mail into the tray, and a narrower mouth at the
35 bottom of the tray through which items of mail can pass to

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be deposited in the merging bin located underneath. The feeder tray therefore acts as a chute guiding the mail pieces into the merging bin placed at the insert position of the conveyor, allowing the operator of the apparatus to quickly and easily insert the rejected items. It will be appreciated that the feeder tray 42 could also be used with the first and second embodiments.

Whilst removing the necessity for manual sorting and therefore saving time, it will be appreciated that the third embodiment uses more space and requires a relatively large sized conveyor.

Figure 4 illustrates the steps taken by a user and by the control means in operating the improved merging apparatus according to the third embodiment of the invention. The diagram is similar to that of Figure 2, except that after step U110 in which the user receives rejected items of mail, the step corresponding to user step U20 in Figure 2 has been omitted, allowing the user to enter the address information of rejected items of mail directly in step U120. Furthermore, an additional step C200 has been included after control step C190 whereby a command to output the mail and disengage the actuator can be issued by the control means. This command is given in response to the an indication from the user being given in user step U140.

In the embodiments described so far, the improved merging apparatus has been described as a separate apparatus to the sorting bins of the sequencing apparatus. It will be appreciated, however, that the improved merging apparatus can be provided as part of a sequencing apparatus and that the control means controlling the sorting apparatus and the merging apparatus can be one and the same. Alternatively, the improved merging apparatus can be provided with an array of sorting bins defined by sorting bin divider plate 16 such that it can be easily

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connected to a sequencing apparatus. The sequencing apparatus would need to be configured to direct mail-pieces to the sorting bins of the improved merging apparatus using its own series of guide means.